CIV 355 – Introduction to Data Science and AI for Civil Engineering
SYLLABUS (Fall 2025)

Stony Brook University
Department of Civil Engineering

COURSE

Course prefix, number, and title:	CIV 355-01, Intro Data Sci & AI for CIV
Meeting time:	Tuesdays and Thursdays, 8:00am – 9:20am
Location:	Frey Hall 326
Course webpage:	https://mycourses.stonybrook.edu

INSTRUCTOR

Name:	Ruwen Qin, Ph.D.
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Office:	2427 Old Computer Science Building
Office hours:	Tu/Th 12:45pm – 13:45pm, or by appointment

COURSE DESCRIPTION

This course introduces the fundamentals of data science and artificial intelligence (AI) for solving civil engineering problems. Through a combination of lectures and hands-on computer labs, students will learn essential techniques for data modification and description, data visualization, sampling, statistical inference, hypothesis testing, and Monte Carlo simulation. The course also covers key concepts of machine learning (ML) and AI, with a focus on their applications in civil engineering. Students will gain experience using relevant Python libraries and modules to apply learn techniques to real-world civil engineering challenges. Prerequisites: AMS310, CIV major; U3 or U4 standing.

The course comprises the following topics:

1. Fundamentals of Python Programming
   - 1.1 Python coding environment
   - 1.2 Numpy: Arrays and vectorized computation
   - 1.3 Pandas: Data structure
   - 1.4 Data cleaning and preparation
   - 1.5 Data loading and storage
2. Data understanding and summary
   - 2.1 Data modification
   - 2.2 Data distribution
   - 2.3 Data description
   - 2.4 Data aggregation and group operations
   - 2.5 Cross-tabulation
3. Data Visualization
   - 3.1 Charts for data visualization
   - 3.2 Matplotlib: Visualization with Python
   - 3.3 Pandas.DataFrame.plot: Make plots of Series or DataFrame
   - 3.4 Plotly: Interactive charts
   - 3.5 Seaborn: Statistical data visualization
4. Modeling data uncertainty with probability
   - 4.1 Uncertainty and probability
   - 4.2 Probability tables
   - 4.3 Review of probability distributions

4.4 Fitting data to distributions

5. Sampling and statistical inference
   5.1 Simple random samples
   5.2 Point estimation
   5.3 Sampling distribution
   5.4 Interval estimation
6. Hypothesis testing
   6.1 Test about proportions
   6.2 Test about means
   6.3 Test about variances
   6.4 One-way ANOVA test
   6.5 Non-parametric methods
7. Case studies: Monte Carlo simulation (optional)
   7.1 Revenue management for airlines
   7.2 Construction project management
8. Learning from data: an introduction
   8.1 Components of learning
   8.2 Components of solution
   8.3 Machine learning problems
   8.4 Types of learning
9. Introduction to artificial intelligence (AI)
   9.1 Neural networks
   9.2 Convolutional neural networks
   9.3 Recurrent neural networks
   9.4 Transformers
   9.5 Generative AI and large language models (LLM)

COURSE MATERIALS

This course does not have an official textbook. Lecture notes, examples, and datasets will be posted on the course webpage in Brightspace.

GRADING

Grading basis

Homework:	50%
Exam:	10%
Project:	25%
Essay:	15%
Total:	100%

Grade scale

This class has pre-defined numerical boundaries that determine the final letter grades.

A	A-	B+	B	B-	C+	C	C-	D	F
[100, 92]	(92, 88]	(88, 84]	(84, 80]	(80, 76]	(76, 72]	(72, 68]	(68, 64]	(64, 60]	(60, 0]

The Undergraduate Bulletin of Stony Brook University states that grades of “D” or better are passing and a grade of “F” indicates failing work.

ASSIGNMENTS

Homework
Five homework assignments will be given for modules 2~6. Practice and homework assignments are opportunities for students to reinforce the knowledge about data science and practice skills of data analysis. Unlimited attempts are allowed before the submission deadline so that students can update their solution files if needed. If a student made multiple attempts by the submission deadline, only the last attempt will be graded.

Exam
One exam covering modules 2~6 will be given. The exam comprises multiple-choice questions and fill-in-the-blank questions.

Project
This course has a project, and teamwork is encouraged. Students will pick a topic of their interest as soon as possible and discuss it with the instructor. Submissions of the project include a proposal, a presentation, and supporting documents.

Essay
Each individual student needs to submit an essay, identifying one application or practice in civil engineering which AI is likely to have impactful contributions.

COURSE POLICIES

Student Accessibility Support Center Statement
If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management
Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Attendance/Participations
Regular attendance is crucial for success in this course. Students are expected to attend every class, report for examinations, and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures, the student is responsible for reviewing posted course materials and finishing missed assignments. Attendance will be tracked, and habitual absence and tardiness may negatively impact your grade. To recognize and reward consistent attendance, a bonus system is in place. Students who maintain excellent attendance throughout the semester, attending all classes punctually, will be eligible for an attendance bonus up to 5 points. This bonus may contribute to your overall course grade.

Email Policy
This document sets forth guidelines for email communication in this course. Excessive emails are problematic for our fellow students, and instructors. Please be sure you have a legitimate need to send an email.

The instructor will answer email covering the following:

- Questions that arise from difficulty in understanding course material or content
- Request for feedback on graded work
- Private issues related to your participation and progress in the course

The instructor will NOT answer emails for the following:

- Questions already answered in this syllabus, contents posted to the course webpage, and lectures. Please look in the posted course material in the course webpage first
- Lack of clear purpose of why the email was sent
- Question unrelated to the course or of an inappropriate nature
- No signature that indicates who send the email
- Being disrespectful, offensive, or using rude language may not receive a response
- Instructors will respond to emails sent on a given day no later than the NEXT WORKDAY
- If the subject of the question would be of general interest, instructors will copy all other members of the class

Policy for Using Generative AI and LLM in Submitted Work

- If AI is used as assistance in any submitted work, students must cite the AI tool(s) used and clearly describe how they were utilized.
- AI tools cannot be used as a complete substitute for the work expected of students. This includes, but is not limited to, generating full solutions, writing entire code segments, or producing major portions of scholarly writing (e.g., essays, reports).
- AI tools may be used for brainstorming ideas, helping to diagnose possible mistakes in coding, polishing text that students have written (e.g., spelling and grammar checks, writing style improvements).